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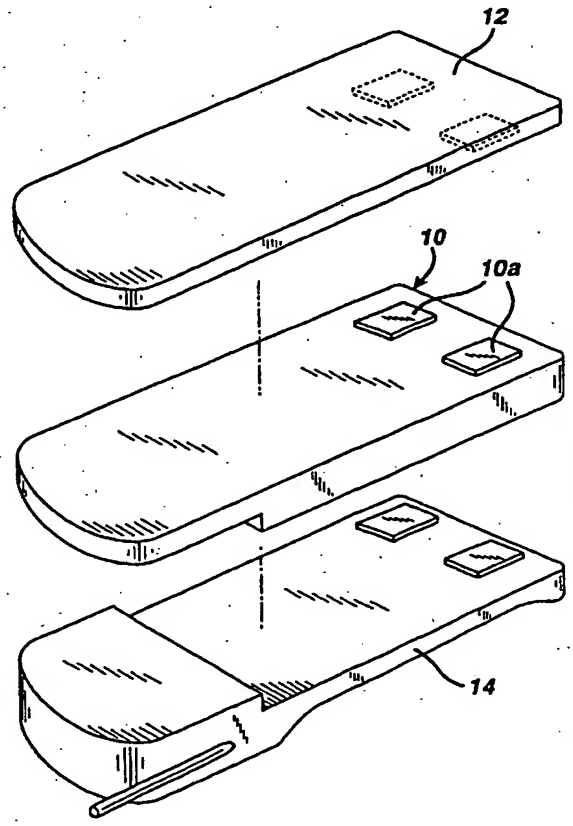
(54) Title: CONSUMER USAGE RECORDER

(57) Abstract

A consumer usage recorder and a method of determining consumer usage characteristic for an electronic device is described. The consumer usage recorder includes a contact board and a logging board. The electronic device with the consumer usage recorder is distributed to consumers. With the electronic device having a portable consumer usage recorder attached, the portable consumer usage recorder permits the consumer to use the electronic device generally in its normal, intended manner. The consumer usage recorder records measurements of characteristic of the device while the electronic device is used by the consumer. At some point the recorded measurements are transferred to an analysis device to analyze usage patterns for the electronic device.



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CONSUMER USAGE RECORDER

This invention relates to obtaining information about usage characteristics of portable electronic devices.

One technique to determine usage characteristics of electronic equipment is to place a person in a room with the equipment and observe how the person uses the equipment. A video camera behind a one-way mirror can be used to record observations and the equipment can be connected to logging and other types of measuring devices to record data on the person's usage of the equipment.

Today many portable devices are powered by batteries. Batteries come in many sizes and types. The equipment that uses batteries is likewise of various sizes, shapes and functions. It is thought that the mode of operation of a device affects battery life. If a constant type of usage pattern or patterns can be established for such devices it is possible that chemistry of the battery can be adjusted or modified based on typical use characteristics to maximize life from the battery.

According to an aspect of the invention, a consumer usage device includes a mechanical arrangement to attach to a consumer device and a battery used with the consumer device, and an electronic logging device that is adapted to measure voltage and/or current from the battery used with the consumer device.

According to an additional aspect of the invention, a method of determining consumer usage characteristic for an electronic device includes distributing an electronic device to a consumer, with the electronic device having a portable consumer usage recorder attached to the electronic device, the portable consumer usage recorder permitting the consumer to use the electronic device generally in its normal, intended manner. The consumer usage recorder records measurements of characteristic of the device while the electronic device is used by the consumer and transfers the recorded measurements to an analysis device over intervals of time to analyze usage patterns for the electronic device.

One advantage to this approach is that it minimizes the intrusion of the testing process on the consumer's usage of the device. The consumer usage recorder is transparent to the consumer that they use the device in a manner they normally use the device. This gives more accurate and realistic data that an

engineer or scientist can use to optimize battery chemistry.

FIG. 1 is an isometric diagram of a electronic battery operated device including a consumer usage recorder.

FIG. 2 is a system block diagram of the consumer usage recorder.

FIG. 3 is block diagram of a logging circuit used in the consumer usage recorder of FIG. 2.

FIG. 4 is a flow chart of the software process that operates the logging circuit of FIG. 3.

FIG. 5 is a diagram of an alternative arrangement for the consumer usage recorder.

Referring now to FIG. 1, a portable, usage logging unit or recorder 10 is coupled between a battery pack 12 and a portable electronic battery operated device 14. The battery operated device 14 can be any type of device, such as, consumer devices including camcorders and cellular or wireless telephones. In FIG. 1, a cellular telephone is shown coupled to its battery pack 12 through the usage logging unit or recorder 10 hereinafter "consumer usage recorder 10". The consumer usage recorder 10 is designed to measure usage patterns of the device 12 and battery 14. The consumer usage recorder 10 can contain its own battery. The consumer usage recorder 10 is disposed to measure voltage, current and temperature while on the device 12.

The usage recorder has mechanical features (not shown) to mount to the device, e.g., the cellular phone, and mechanical features 10a to mount to the battery. These features are duplicated on either side of consumer usage recorder 10 so the battery 12 can attach to one side of the consumer usage recorder 10 and the device 14 can attach to the other side of the consumer usage recorder 10. The consumer usage recorder 10 is constructed to be as thin as possible, so that the presence of the consumer usage recorder 10 will not significantly interfere with the consumer's use of the device 12.

The consumer usage recorder 10 can be mounted on various types of devices. When mounted on cellular phones, the cellular phones can be given to a test market group of consumers to determine typical characteristics of usage. The consumer usage recorder 10 will take measurements and provide data that can be

analyzed. This data can tell how often and for how long the device was used. By examining large amounts of such data it may be possible to arrive at usage patterns for different types of electronic devices. For example, analysis of the data can be used to determine if consumers leave the device on continuously, or do they turn it on and off. For cellular phones the data could indicate that users talk for 5 minutes and then turn the phone off for a substantial part of the day, and so forth. That type of information has been very difficult to attain. With this data, a battery manufacturer, for example, can determine optimum chemistry characteristics of batteries intended for particular applications based on expected usage patterns.

For example, usage of a battery in a flashlight is very different from usage in a cellular telephone. A battery in a flashlight will likely see continuous usage; whereas, the usage in a phone may be different. Because of the differences in usage patterns the chemistry of the batteries can be important to optimize a battery for different applications or even provide customized batteries optimized for expected usage patterns for the same device application.

Referring now to FIG. 2, the device battery pack 14 is connected to the consumer usage recorder 10 on one side and on the other side to the device 12, e.g., cellular telephone. The consumer usage recorder 10 includes a contact board 22 containing electrical connections to connect the battery pack 14 to the device 12 through the consumer usage recorder 10, as well as circuits 24 to sense and measure voltage, temperature and current. The contact board 22 can contain a sense resistor (not shown). The sense resistor can be connected between the battery and the device so that current from the battery flows through the resistor and produces a voltage drop that is measured to obtain a reading of the current. The resistor would have a very low resistance value to minimize voltage drop across the resistor.

The consumer usage recorder 10 also includes a logging board 24. The logging board 24 includes a microprocessor based logging system that converts analog measurements of voltage, temperature and current into digital measurements. The microprocessor based logging system would also store the measurements. The consumer usage recorder 10 also includes a battery 26 so that the consumer usage recorder 10 is self powered. The consumer usage recorder 10 also has an interface. The interface could be a serial interface, e.g, an RS-232 interface 28. When it is

desired to retrieve information from the consumer usage recorder, the microprocessor can download the data into a computer 29, via the interface 28 to perform data analysis processing and determine usage patterns of the device 12.

The logging board 24 is connected to the contact board 22 and receives analog signals that correspond to the voltage of the battery, current drawn out of the battery and temperature. The logging board 24 could also be configured to detect rechargeable batteries and could measure current into the battery during recharging. The consumer usage recorder 10 includes a temperature sensor to detect the ambient temperature that the consumer usage recorder 10, battery 14 and device 12 are operating in. Temperature conditions may affect battery chemistry. The logging board 24 will sample the voltage and the current and determine what state the device 12 is in. In the case of a cell phone, the cell phone can be in "talk mode", "standby", or "off." Also the battery may not even be attached to the device 12 and that state can also be detected.

Referring now to FIG. 3, the logging board 24 includes a microcontroller 30, a real-time clock 32, an analog-to-digital converter 34, and electrically erasable memory 36 to record data. The microcontroller 30 also includes program memory 49 that includes a logging process 50 (FIG. 4). The logging board 24 also includes a battery 39 and power regulation 38. The microcontroller 30, real-time clock 31, and electrically erasable memory 36 are coupled via a bus 32. In this embodiment, the microcontroller 30 includes a serial interface 28 and the A/D converter. The A/D converter 34 is coupled to an interface, e.g., signal conditioning circuit 33 that couples temperature T, voltage V and current I sensors to the A/D converter 34. The logging board 24 can be a modified, commercially available one such as a Scott Edwards Electronics Sierra Vista, AZ 85636-0160 BS2 Data Collection Proto Board data logging board.

The microcontroller controls data logging through the analog-to-digital converter. The microcontroller calculates the voltage and current from the battery, maintains the current time, and determines ambient temperature. The microcontroller records this information in a data store 36, e.g., the electrically erasable memory. The microcontroller also controls downloading of the recorded data, e.g., to transfer the data to a personal computer via interface 28.

In order to save memory space, the microcontroller can do time-based sampling, measuring and calculating parameters at fixed periods of time, e.g., every five seconds. The microcontroller can record voltage, current and temperature. Another way to record data that saves even more memory is to perform event based sampling. The microcontroller determines what mode the device is in based on receiving an event. Once the microcontroller determines that an event occurred, the microcontroller records when that event occurred, the nature of event, e.g., a transition from "off" mode to "standby" and so forth. The microcontroller records that information, as well as the voltage, current, time, and temperature. The consumer usage recorder 10 produces discrete records that have time stamps and mode stamps. This allows a small amount of memory to be placed on the logging board 24 reducing physical space and power requirements, while permitting recording for an extended period of time.

Referring now to FIG. 4, a process 50, stored in program memory, e.g., 49, to control operation of the microcontroller is shown. Upon power up of the microcontroller 30, it will go through an initialization process 52. The initialization process 52 can perform various routines such as clearing registers, and so forth. After initialization 52, the software enters a menu mode 54 waiting for a command to come from the interface. The process 50 is set up as a menu driven command type that operates based on commands received from the interface 42. This can enable the microcontroller to perform functions such as starting a logging operation, setting the real-time clock, calibrating electronics and so forth.

The calibration mode 60 is used to set voltage references and make adjustments to the circuitry, set configuration variables 62, such as how many samples to take, and so forth. This permits the same basic logging algorithm to be used for different applications allowing for modifications based upon the application.

In the logging mode 66, the microprocessor will go into a sleep state, i.e., low power mode when it is not logging data. It will wake up from the low power mode, looking for new commands from the interface 28 or determine if it is time to take a measurement. That is, the microcontroller periodically turns on based on a time guide e.g., wake up every 5 seconds, every 10 seconds looking for a new

command or take a measurement. If there are no commands, it turns itself off. If already in a sampling mode it will sample values at the analog-to-digital converter to obtain data to measure the current and voltage of the device and determine 66b whether the device, e.g., the camcorder entered a different operating mode. The microcontroller causes measurements of the voltage across the battery and the voltage across the sense resistor to give a current reading.

The microcontroller can determine 66c from those two measurements whether the device 12 is in the same mode. If it is in the same mode 66a, the microcontroller will go back to sleep, i.e., return to the initial logging mode state 66. If it is in a new mode 66e, the microcontroller will determine the new mode 66b based upon some stored parameters. The microcontroller will produce a record 66f specifying the new mode, voltage, current, time and temperature and store 66g that record in memory.

Part of the data loaded during calibration and configuration can be thresholds and levels that the logging software can use to determine if different modes have been entered. This is desirable because some cellular phones have very noisy current patterns so the consumer usage recorder may have to sample a number of times and average those samples to determine what mode the device 12 is in.

The process 50 also includes a downloading mode 70. The downloading mode is entered via a command from the interface 28. It causes the consumer usage device 10 to download all data records in memory 36 to an analysis device such as a computer 29 (FIG. 3). Thus, in an event driven process, once the microcontroller has sampled the voltage, current and temperature, and determined the mode, the microcontroller will save that information into the memory 36 if the mode has changed. If the mode has not changed, the microcontroller will go back to sleep and will continue in that loop until it is commanded from the interface 28, e.g., an RS232 type interface, to go back to the menu mode. In the event driven mode, the microcontroller only causes the information to be stored in memory and make a record when the device changes modes. Alternatively, the logging can occur at regular intervals, e.g. time-based sampling.

Thus, the microcontroller can be configured to record at every time interval i.e., a time-based sampling or only record the information when an event

changes, i.e. event-based sampling. It might be desirable to allow the logging board to operate using both techniques. The time-based sampling could be used to obtain some initial data and once it is understood how a particular device works, i.e., what kind of averaging and thresholds are needed, the microcontroller can be switched to an event-based processing.

In addition to measuring voltage, current and temperature, other measurements are possible, such as humidity, by coupling a humidity sensor, or motion by coupling a motion sensor to the signal conditioning circuit 33. For some type of devices it might be helpful to determine if acceleration takes place in the device. A camcorder manufacturer may want to know how long a user can hold a camcorder steady in order to design steadying features into the camcorder.

One consideration with designing the consumer usage recorder is maximizing the consumer usage recorder's battery life. In the case of a camcorder, the camcorder may be used infrequently. There can be a very long period of time between downloading the data and using the consumer usage recorder. If the data logger is run continuously even at a 5 sec rate, it would draw a certain amount of power from the battery. Therefore, one approach would detect when the camcorder was moved, e.g., by employing a tilt switch, (e.g., a mercury switch or a pendulum type switch) that would trigger the data recorder to start recording, and if there was no event, the consumer usage recorder would go back into a power saving mode.

Referring now to FIG. 5, an alternate embodiment of the consumer usage recorder 10′ is shown. This embodiment of the recorder 10′ can be used when a battery 12′ is disposed in a battery compartment 14a of a consumer device 14′. The recorder 10′ includes a contact board 22′ that is interposed between one of a pair of battery terminals 15a, 15b and electronics (not shown) of the device 14′. It also includes the logging board 24 affixed to or incorporated into the device 14′.

It is to be understood that while the invention has been described in conjunction with the detailed description thereof, the foregoing description is intended to illustrate and not limit the scope of the invention, which is defined by the scope of the appended claims. Other aspects, advantages, and modifications are within the scope of the following claims.

CLAIMS

1. A consumer usage device comprising:

a body including a mechanical arrangement to attach to a consumer device and a battery used with the consumer device, with said body housing:

an electronic logging device that is adapted to measure voltage and/or current from the battery used with the consumer device.

2. The consumer usage device of claim 1, wherein the mechanical arrangement is disposed in a housing that attaches between the consumer device and the battery used with the consumer device.

3. The consumer device of claim 2, wherein the housing includes the electronic logging device.

4. The consumer device of claim 1, wherein the mechanical arrangement is a contact board that is disposed to sample current and voltage from a battery disposed in a battery compartment of the consumer device.

5. The consumer usage device of claim 3, wherein the housing is adapted to attach to a cellular telephone.

6. The consumer usage device of claim 5, wherein the mechanical arrangement includes:

a first mechanical arrangement to connect to a backside portion of the cellular telephone; and

a second mechanical arrangement to attach to the battery so that the body is disposed between the cellular telephone and the battery.

7. The consumer usage device of claim 1, wherein the logging device comprises:

an alterable memory; and

a microcontroller to calculate voltage and current measurements from the battery, and to store the measurements in the alterable memory.

8. The consumer usage device of claim 7, wherein the logging device further comprises:

a real time clock; and

wherein the microcontroller maintains a current time and assigns the current time to the measurements.

9. The consumer usage device of claim 7, wherein the microcontroller further controls downloading of the stored data to an analyzing device.

10. The consumer usage device of claim 7, wherein the microcontroller performs time-based sampling, to measure and calculate the values of current and voltage.

11. The consumer usage device of claim 7, wherein the microcontroller performs event based sampling.

12. The consumer usage device of claim 11, wherein to perform event based sampling, the microcontroller determines the mode of operation of the device based on a received event.

13. The consumer usage device of claim 12, wherein the microcontroller records the nature of the event, and voltage, current and/or time.

14. The consumer usage device of claim 12, wherein the microcontroller produces discrete records that have time stamps and mode stamps.

15. The consumer usage device of claim 12, wherein the microcontroller produces discrete records that have time stamps and mode stamps and measured metrics of the battery.

16. The consumer usage device of claim 12, wherein the logging device further comprises:

a battery to provide power to the consumer usage device.

17. The consumer usage device of claim 1, wherein the body is adapted to attach to a cellular telephone, and the body has a first mechanical arrangement to connect to a backside portion of the cellular telephone and a second mechanical arrangement to attach to the battery so that the body is disposed between the cellular telephone and the battery; and

the logging device comprises:

an electronically alterable memory;

a real time clock;

a temperature sensor;

an analog to digital converter to sample values from the real time clock, temperature sensor and the battery pack; and

a microcontroller to calculate voltage and current measurement from

battery, and to store the measurements along with values of time and temperature in the memory.

18. A method of determining consumer usage characteristic for an electronic device comprises:

distributing an electronic device to a consumer, with the electronic device having a portable consumer usage recorder attached to the electronic device, the portable consumer usage recorder permitting the consumer to use the electronic device in its normal, intended manner; and the consumer usage recorder:

recording measurements of characteristic of the device while the electronic device is used by the consumer; and

transferring the recorded measurements to an analysis device over intervals of time to analyze usage patterns for the electronic device.

19. The method of claim 18, wherein the electronic device is a cellular telephone, and the consumer usage device is attached between the cellular telephone and battery pack used by the cellular telephone.

20. The method of claim 18, wherein distributing further comprises:

distributing a plurality of such electronic devices to consumers with each of the electronic devices having a portable consumer usage recorder and a battery attached to the electronic device.

21. The method of claim 20, wherein recording further comprises:

determining the voltage of the battery packs and current drawn from battery packs during use of the electronic devices.

22. The method of claim 21, wherein recording further comprises:

recording time stamps for each recorded measurement of voltage and current.

23. The method of claim 21, wherein recording further comprises:

determining a mode of operation of the electronic device; and

recording mode stamps and time stamps for each recorded measurement of voltage and current.

FIG. 1

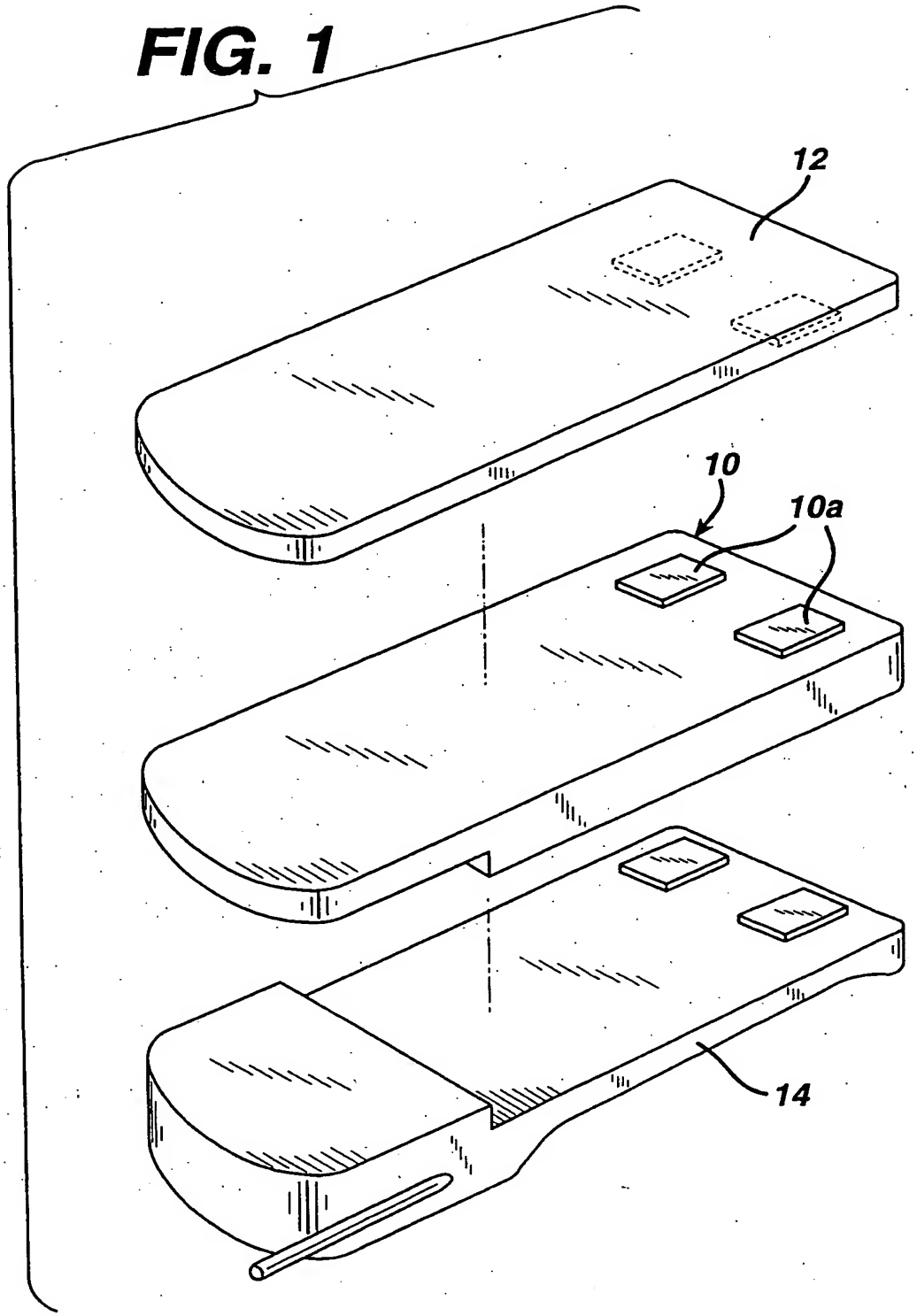
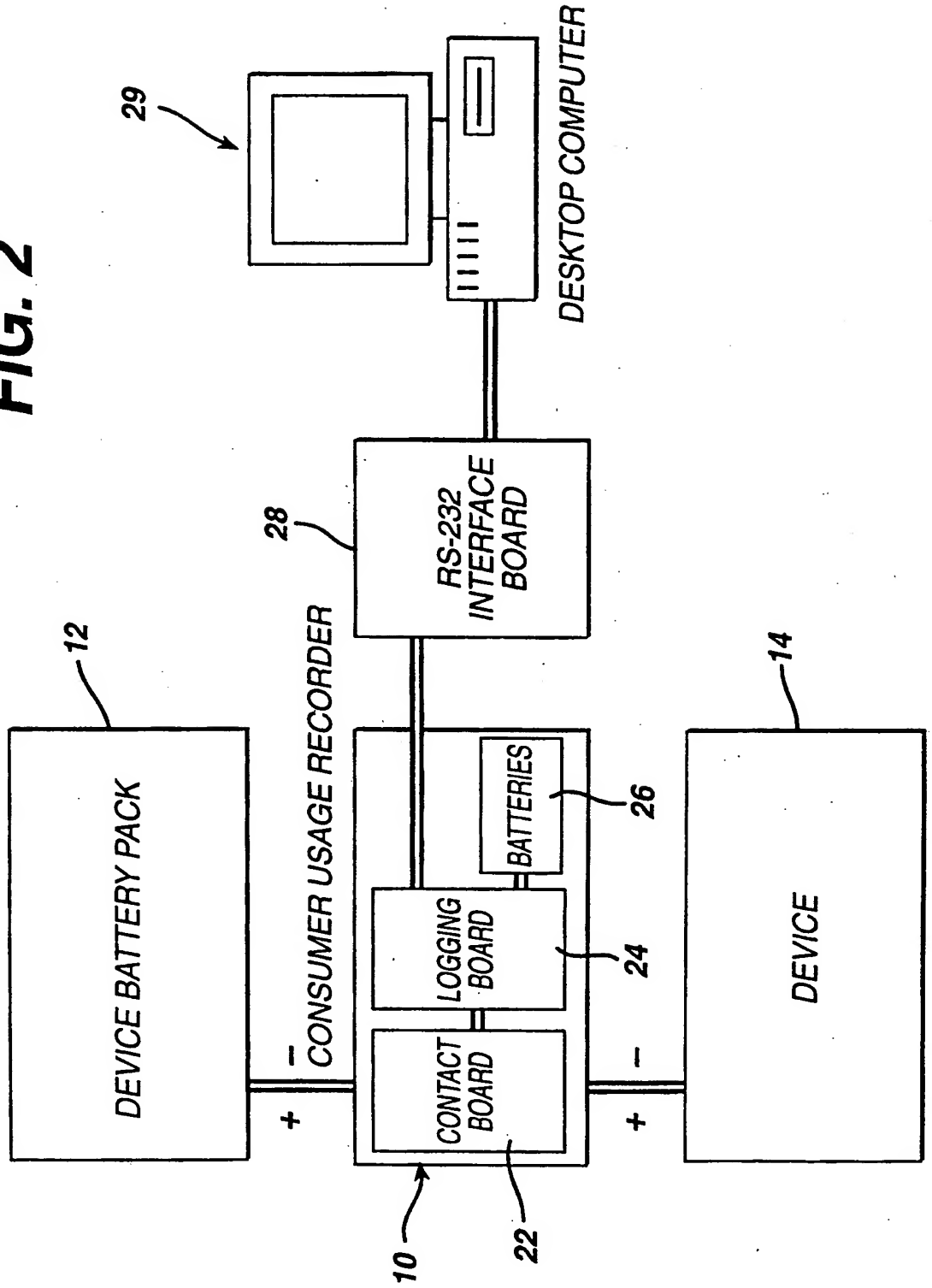


FIG. 2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RS-232 INTERFACE BOARD
12
DEVICE BATTERY PACK
CONSUMER USAGE RECORDER
BATTERIES
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LOGGING BOARD
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CONTACT BOARD
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DEVICE
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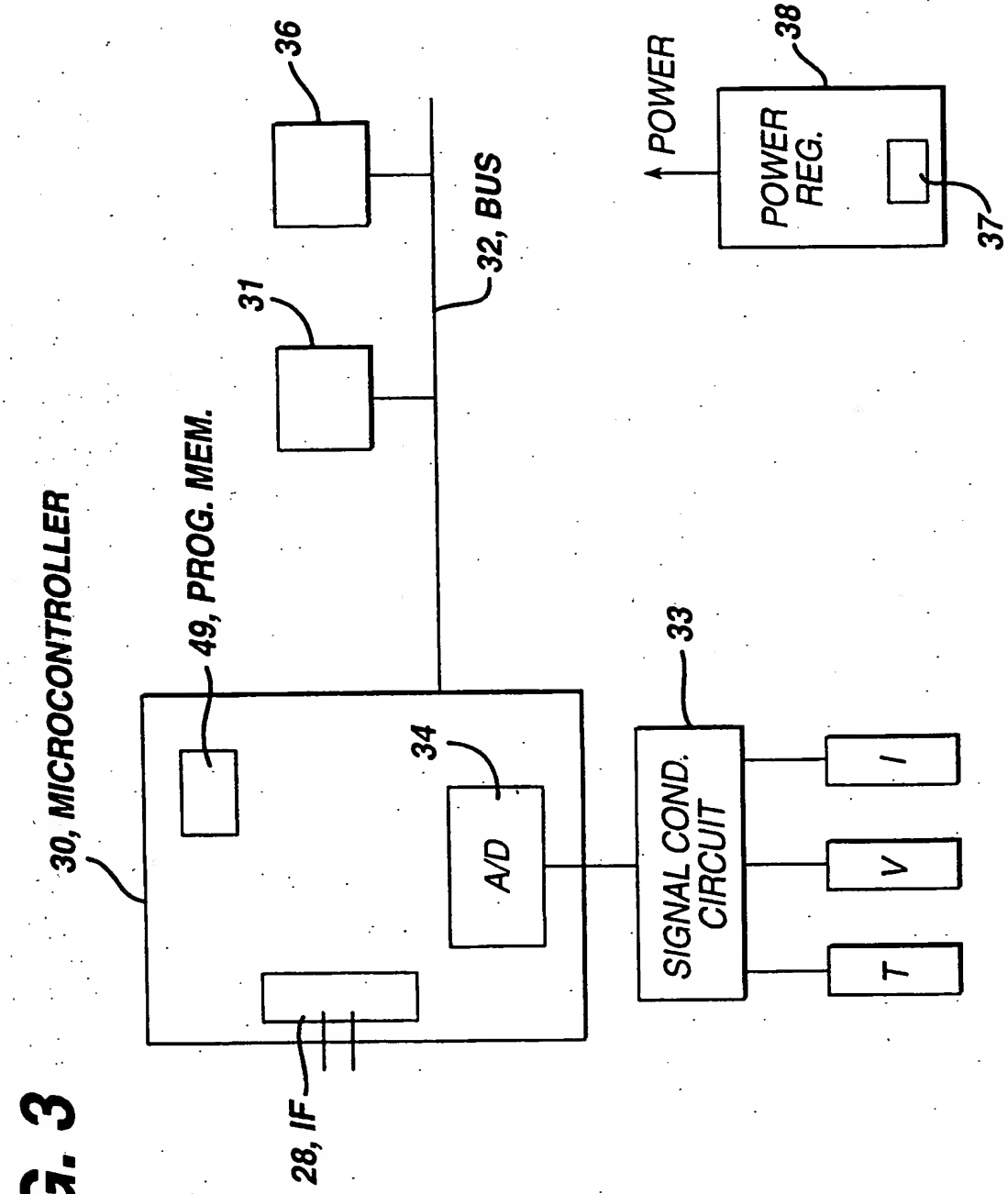
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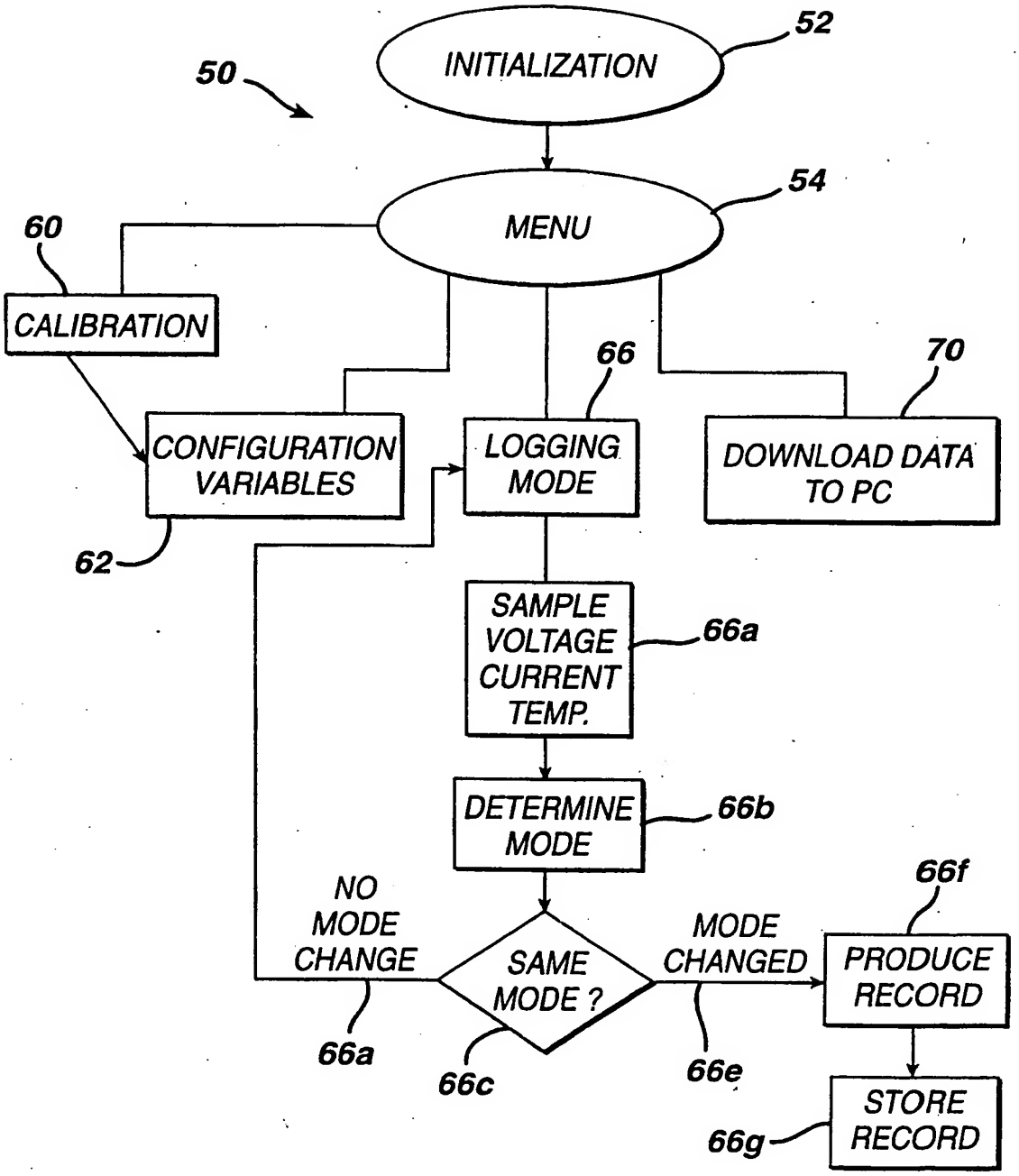
FIG. 3

FIG. 4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PRODUCE RECORD
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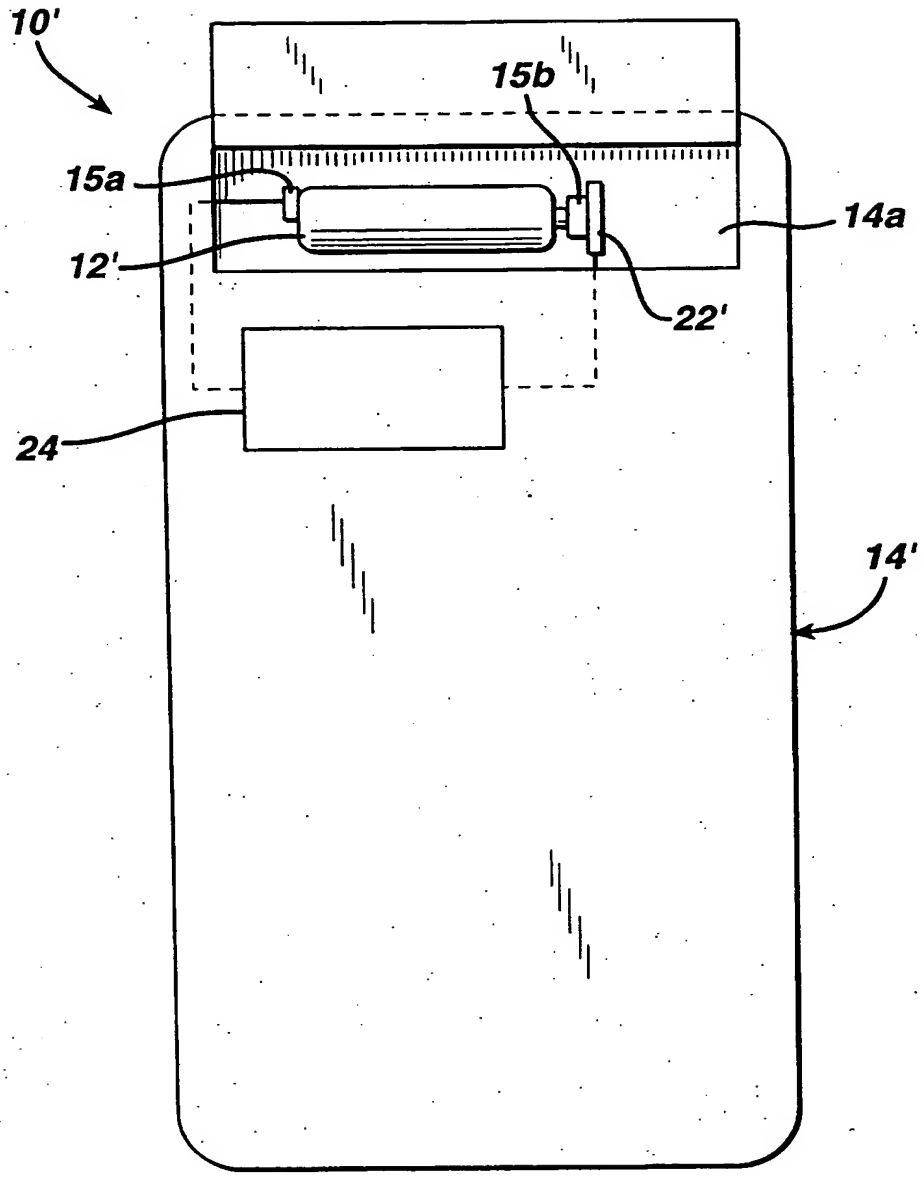
FIG. 5



INTERNATIONAL SEARCH REPORT

Intl Jonal Application No
PCT/US 00/09524

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01R31/36

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 98 52061 A (DUJON GREGORY FRANCIS ;LG UK LTD (GB)) 19 November 1998 (1998-11-19) claims 1,2,4	1,7,9,18
X	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 14, 31 December 1998 (1998-12-31) & JP 10 233826 A (SONY CORP), 2 September 1998 (1998-09-02) abstract	1,18

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